NHTSA'S VEHICLE PARAMETER DATABASE AND NHTSA'S CRASH TEST DATABASE

Catherine A. McCullough
Barbara Hennessey
National Highway Traffic Safety Administration
United States Department of Transportation
United States of America
Paper No. 403

ABSTRACT

This paper will describe the contents, development, and use of the National Highway Traffic Safety Administration's (NHTSA) Vehicle Parameter and Crash Test databases in crash analysis and injury determination. The information can also be used as a source for vehicle computer model/simulation programs or in the development of crash avoidance measures.

The analyses of damage sustained by vehicles in crashes is based on post-crash information and is somewhat limiting since pre-crash measurements are not usually known or readily available.

The Vehicle Parameter Database consists of over 110 key vehicle dimensions and specifications on over 10,000 vehicles between model years 1980 to 2003.

This database can be cross referenced to NHTSA's Vehicle Crash Test Database which contains both static post crash measurements and dynamic sensor time history data from over 4,000 tests for model years 1965 to 2003. This database contains information on vehicle deceleration and deformation characteristics, and dummy response, in several crash modes. The ability to compare pre-crash and post crash basic vehicle measurement characteristics could provide a greater insight into analyzing vehicle damage, degree of intrusion, level of deformation, and injury severity/source.

INTRODUCTION

A key element in NHTSA's mission is to provide national leadership in the advancement of the science and art of motor vehicle safety. A variety of research, analysis and engineering development programs are planned, organized, and conducted to carry out this mission. These programs result in improved levels of crash protection for motorists.

The Vehicle Parameter Database contains pre-crash measurements. The Crash Test Database contains post-crash measurements, dynamic sensor time history data, vehicle deceleration, deformation characteristics, and dummy responses. These databases can be combined to provide greater insight into understanding and analyzing crash kinematics and injury mechanisms.

This paper describes the development, content, and use of these databases in crash data analysis and injury determination. The information can also be used as a source for vehicle computer model/simulation programs or in the development of crash avoidance measures.

BACKGROUND

The Vehicle Parameter Database was originally developed in 1994 through joint efforts of NHTSA's Office of Crashworthiness Research and the Volpe National Transportation Systems Center (VNTSC). It was created as a follow on to the Safety Attributes Databook developed by NHTSA in the mid-1980's that contained specification information on approximately 5,000 passenger cars between model years 1965 and 1983.[1] The downsizing of the fleet, and the subsequent introduction of larger sport utility vehicles (SUV's), as well as the introduction of improved safety equipment, increased the need for a single source of reliable up-to-date vehicle specification information for crash reconstruction, vehicle modeling and simulation, and development of crash avoidance measures.

The Vehicle Crash Test Database was originally developed in 1979 to electronically store test specification data and sensor time history outputs that were previously only contained in paper test reports. It was designed to provide a single repository for full scale vehicle and sled tests conducted by the agency and other testing entities, standardization of data collection methods, and permanent access to event data for computational processing. For each test, data are recorded from various sensors mounted to the

test dummies or vehicles, high-speed films or videos are recorded to document the event, still pictures of the test setup pre- and post-event are taken, and a written report is generated.

DATABASE DEVELOPMENT

Information contained in the Vehicle Parameter Database is based on vehicle specification sheets prepared by the automobile manufacturers on their fleet. Specification sheet data is based on two SAE Recommended Practices – SAE J1100, Motor Vehicle Dimensions, and SAE J826, Devices for Use in Defining and Measuring Vehicle Seating Accommodations. SAE J1100 defines a uniform set of interior and exterior dimensions for passenger cars, multipurpose vehicles and trucks. SAEJ826 provides the means by which passenger compartment dimensions can be obtained by using a deflected seat rather than a free seat contour as a reference for defining seating space. This recommended practice also specifies a two-dimensional H-point template and three-dimensional H-point machine devices for use in defining and measuring vehicle seating accommodations.

In some cases, such as missing information on fuel tank variables, data was received directly from the manufacturers. We are grateful to them for updating the original information.

Coding manuals for the National Automotive Sampling System (NASS) were used to assign make and model codes that formed the basis for the variables NMAKE and NMODEL respectively. These codes were incorporated into the database to make it compatible with NASS to support a variety of research projects.

Information contained in the Vehicle Crash Test Database is provided by the laboratories conducting crash tests in strict adherence to the data format set forth in the NHTSA Test Reference Guide, Volume 1: Vehicle Tests. [2] The guide defines a set of coded, free text, and numeric parameters for information describing the test setup, vehicle, occupants, restraints as used, crash barrier or striking vehicle, and time history sensor instrumentation. NHTSA also provides data entry software that performs a variety of error checks on the formatted data. This ensures consistency in coding, case, and field length for text, and range and polarity for numeric data. Over the course of the years as vehicles, anthropomorphic test devices, and crash test configurations have become more complex, the database has been enhanced to reflect these changes. Many codes have been added, for example, to describe advanced and multiple restraint systems such as dual stage and side curtain air bags, but the database remains backward compatible, so that current tests can be compared to older ones as necessary.

On receipt, the test data is loaded into an Oracle platform relational database, where additional quality checks are conducted, and then ultimately released to the public through the NHSTA web site. Data may then be viewed on-line through an interactive query interface, or downloaded in a variety of customized ASCII formats.

DATABASE COMPOSITION

The original Vehicle Parameter Database contained nearly 101 measurements on approximately 2,800 vehicles from vehicle model years 1980 to 1994. Several enhancements have been made since the database was first reported on in 1995.[3] The database currently contains approximately 110 measurements on over 10,000 vehicles from model years 1980 to 2001. Angle measurements are in degrees. All other data measurements are in standard metric units.

Field names for the data on the fuel tank have been standardized according to naming conventions used by the NASS, i.e., specifying location of the fuel tank in reference to the rear axle, and incorporated into the database. For analytical purposes, based on consultation with a variety of engineers and crash reconstructionists, some of the data has been grouped to be less specific. For example, the tank attachment contained information on the number of bolts, screws, or bands. This specificity has been eliminated in favor of a more “generic” field indicating bolts, screws, straps/bands. Descriptive data for vapor line, return line, and fuel line material (aluminum, carbon steel, nylon) and fill pipe material (aluminum, coated steel, plated steel, and integrated plastic) likewise gave way to metallic, non-metallic and combination in those cases where both metal and non-metal materials were indicated.

Information has also been added on recommended cold tire pressure, separate measurements for front and rear curb weights, diesel, turbo, manufacturer location, emission state, description of model, and notes on model differences.

Figure 1 shows the overall contents of this database.

Restraint Related Designated Seating Positions Belt Type Airbag 12 data elements	**Fuel Tank** Location Capacity Fuel Type Tank, Hose and Line material 12 data elements	**Interior Vehicle Geometry** SgRP Back Angle Hip Angle 47 data elements
Exterior Vehicle Geometry Height Width Length Wheelbase Tire Size 24 data elements	**General Vehicle** Year, Make, Model Brakes, Engine, etc Emission State Mfg Code Cold Tire Pressure Curb Weight – Total, Front and Rear 24 data elements	

Figure 1.

Vehicle Parameter Database.

The Vehicle Crash Test Database consists of six linked tables of test, vehicle, barrier, occupant, restraint, and instrumentation information, and associated sensor time history outputs. The test table contains general descriptive information such as the test performer, title, test objective, closing speed, and impact angle of the test. The vehicle table contains vehicle descriptors such as make, model, year, vehicle identification number (VIN), body type, and crush profile measurements. The barrier table describes the type of fixed barrier used if the test is a vehicle-to-barrier test. The occupant table describes each occupant seated in the test vehicle, clearance distances to interior surfaces, and some calculated injury assessment values. The restraints table contains information on all of the restraints, active or passive, as used, at each occupied seating position. The instrumentation table describes the location, type, attachment, axis, engineering units, sampling rate, signal duration, start and end time of each sensor used in the test.

All measurements are recorded in standard metric units. The tables are linked through a combination of key fields: Test Number, Vehicle Number, Occupant Number, Occupant or Sensor Location, and Restraint Number.

Tests are generally classified by their purpose or test type (e.g., New Car Assessment Program, Federal Motor Vehicle Safety Standard No. 208, compliance), configuration (e.g., vehicle-to-vehicle, vehicle-to-barrier, rollover), closing speed, impact angle, make, model, and year, but searches may be refined using many other criteria. The database contains over 250 searchable fields in its six linked tables.

Recent enhancements include detailed information on child seat performance. A refined search may only include tests where child seats were mounted using lower anchorages and top tethers (LATCH).

Figure 2 shows the overall contents of this database.

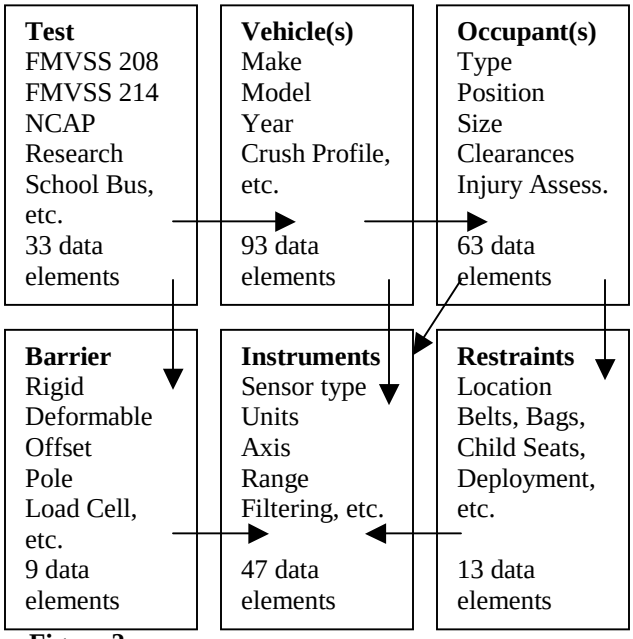

Figure 2.

Vehicle Crash Test Database.

DATABASES USES

Both the Vehicle Parameter and the NHTSA Crash Test databases are used for in-house analysis and have been requested by hundreds of manufacturers, crash investigators and crash reconstructionists over the years. They may be used independently or together, depending on user needs, and provide professionals with the tools needed for analyzing vehicle damage, degree of intrusion, level of deformation, occupant kinematics and injury source.

Researchers have used the Vehicle Parameter Database to:

- Link to the National Automotive Sampling System (NASS) through common numeric NMAKE and NMODEL codes to determine pre-crash measurements when analyzing intrusion and deformation in the NASS data or in independent crash reconstruction projects.

- Provide geometrical input to crash simulation programs to examine issues like vehicle compatibility.

- Compare parameters that effect crash avoidance measures for handling and stability, such as vehicle size (length, height and wheelbase), curb weight, GVWR, tire size, engine, transmission, and brake information.

Researchers have used the Vehicle Crash Test Database to:

- Compare vehicle crash characteristics in a variety of crash modes such as low and high speed, front, side, rear, oblique angle and offset.

- Analyze restraint performance for different sized occupants through injury assessment computation.

- Develop test procedures and analytical tools for upgrades to the 200 and 300-series Federal Motor Vehicle Safety Standards.

DATABASE AVAILABILITY

The basic Vehicle Parameter Database is currently available by contacting Catherine McCullough at Catherine.McCullough @ NHTSA.DOT.Gov.

The enhanced database described in this paper will be available on NHTSA's Applied Research web site http://www-nrd.nhtsa.dot.gov/database/nrd-11/veh_db.html. by December 2003.

The Vehicle Crash Test database is made available in a variety of formats and subsets on the NHTSA's Applied Research web site at http://www-nrd.nhtsa.dot.gov/database/nrd-11/veh_db.html.

An interactive query interface allows for viewing of single or multiple tests, and downloads of the data traces in several optional formats.

The entire database, excluding the data traces, may be downloaded from the same site as ASCII pipe-delimited text files.

FUTURE PLANS

The Vehicle Parameter Database will be updated as new specification sheets are received.

Work is in progress to link several additional information tables to the Vehicle Crash Test Database. Prototype tables are available now and are being populated with data on floor pan intrusion measurements and child seat performance in a subset of tests.

A new information set, the Vehicle Trends Database, contains additional tire, sales and registration data, Instituto Universitario de Investigación del Automóvil (INSIA) measurements, and three categories of carry over years based on wheelbase, NCAP twins, and the Insurance Institute for Highway Safety (IIHS) weight class. These tables will be incorporated into the Vehicle Crash Test Database by December 2003.

REFERENCES

(1) Walter, Robert A., Kats-Rhoades, Lenore, NHTSA Vehicle Safety Attributes Databook SAE #387034

(2) NHTSA Test Reference Guide, Version 5, Volume I: Vehicle Tests, http://www-nrd.nhtsa.dot.gov/software/test-reference-guides/test-reference-guides.html

(3) McCullough, Catherine A., Hollowell, William T., Battisti, Peter, Applications of NHTSA's Vehicle Parameter Database, SAE # 950360

ACKNOWLEDGEMENTS

The authors also wish to acknowledge the work by Peter Battisti at the Volpe National Transportation Systems Center (VNTSC); David Gundersen at CSC/SI International; and Maryann Keyes of Keyes Consulting. Peter and David were responsible for all the data entry since 1993. David, most recently was responsible for coding the additional variables into the database. David and Maryann were invaluable in the quality control work on the fuel tank variables.